Remarks

I. Introduction

This is in response to the final Office Action dated October 18, 2006 and is being submitted simultaneously with a Request for Continued Examination pursuant to 37 C.F.R. § 1.114.

The Office Action rejected claims 21 and 23-30 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,500,076 to Jerbic (Jerbic). The Office Action rejected claim 22 under 35 U.S.C § 103(a) as being unpatentable over Jerbic in view of Applicant's Admitted Prior Art.

Claim 21 has been amended to more particularly point out and distinctly claim the invention. New claims 31 and 32 have been added.

Claims 21-32 remain for consideration.

II. Rejections under 35 U.S.C. §102(b)

Independent claim 21 was rejected as being anticipated by Jerbic. In order for a claim to be anticipated under 35 U.S.C. §102, **each and every** limitation of the claim must be found either expressly or inherently in a single prior art reference. PIN/NIP, Inc. v. Platte Chem. Co., 304 F.3d 1235, 1243 (Fed. Cir. 2002). In the present case, Jerbic does not show each and every limitation of independent claim 21. Therefore, applicants request the withdrawal of the rejections under 35 U.S.C. §102(b).

The present invention discloses apparatus for controlling an etch rate on a semiconductor substrate. As illustrated in FIG. 3, an etchant gas and a non-etchant gas are input to an etch chamber 50 via first and second mass flow controllers 54 and 57. Optical devices are used for determining a concentration of the etchant gas and a concentration of the non-etchant gas. For example, in FIG. 2, light detector 82 produces a signal representing the concentration of the etchant gas in the etch chamber 50, and light detector 84 produces a signal representing the concentration of the non-etchant gas in the etch chamber 50. The light detectors 82 and 84 are connected to a dividing element 90, which

divides the etchant gas concentration signal by the non-etchant gas concentration signal in order to generate a normalized etchant gas concentration signal. The dividing element 90 is connected to a first input terminal of a comparator 92. Thus, the first input terminal of the comparator 92 inputs the normalized etchant gas signal. A second input terminal of the comparator 92 inputs a reference signal which represents a desired etchant gas concentration. The comparator 92 compares the normalized etchant signal with the reference signal and outputs an error signal as a result of the comparison. This error signal is used to control the first mass flow controller 54 in order to adjust the concentration of the etchant gas in the gas chamber 50. Accordingly, the concentration of the etchant gas in the gas chamber is controlled based on comparison between a reference signal and ratio of the etchant gas concentration and the non-etchant gas concentration.

These aspects of the present invention are recited in independent claim 21, as amended. In particular, claim 21 recites the limitation of:

> a comparator having a first input terminal receiving the normalized etchant gas concentration signal and a second input terminal receiving a reference signal representing a desired etchant gas concentration, the comparator for outputting an error signal for controlling the first mass flow controller, said error signal representing a difference between said reference signal and said normalized etchant gas concentration signal.

Jerbic does not disclose the limitations of independent claim 21 as amended, and therefore does not anticipate amended claim 21 under the strict anticipation standard of 35 USC §102.

Jerbic is directed to adjusting the concentration of a reactant gas in a plasma etch process or a plasma deposition process. As described at column 3, lines 7-25 of Jerbic, the concentrations of a reactant gas and a non-reactant gas are quantitatively measured, a ratio of the measured concentrations is then obtained. The ratio is monitored for any change and a flow controller is

controlled based on any change in this ratio. Accordingly, Jerbic simply keeps the concentration of reactant gas constant, but does not use a reference value to select a desired concentration of reactant gas. At column 4, lines 57-50, Jerbic describes an actinometry apparatus which derives the ratio of the react gas concentration and the non-reactant gas concentration and monitors the ratio. The actinometry apparatus adjusts the set point on the flow controller of the react gas in response to any change in the ratio. At no point is a signal representing this ratio input to a comparator to be compared with a reference signal representing a desired concentration of the reactant gas. Furthermore, no comparator is described at any point in Jerbic. Therefore, Jerbic does not disclose "a comparator having a first input terminal receiving the normalized etchant gas concentration signal and a second input receiving a reference signal representing a desired etchant gas concentration, the comparator outputting an error signal for controlling the first mass flow controller, said error signal representing a difference between said reference signal and said normalized etchant gas concentration signal," as recited in independent claim 21.

Thus, for the reasons discussed above, independent claim 21 is allowable over the cited art. Claims 22-32 are dependent upon an allowable independent claim and are therefore also allowable.

New claims 31 and 32 are also allowable over Jerbic for at least the following additional reasons.

Regarding claim 31, claim 31 recites the limitations of:

> an integrator connected to an output terminal of said comparator to input said error signal output from said comparator, said integrator integrating said error signal over time; and
>
> an adder having a first input terminal connected to an output terminal of said integrator to input the integrated error signal, a second input terminal inputting a recipe set point value representing a nominal control voltage of said first mass flow controller, and an output terminal connected to said first mass flow controller, said adder adding said integrated error signal to said recipe set point value to generate a modified

control signal and outputting said modified control signal to said first mass flow controller.

FIG. 3 of the present invention shows that the output terminal of the comparator 92 is connected to an integrator 100. The error signal output by the comparator 92 is integrated over time by the integrator 100. The integrated error signal is input to a first input terminal of an adder 102. A second input terminal of the adder 102 inputs a recipe set point value, and the adder 102 adds the integrated error signal to the recipe set point value in order to generate a control signal to control the first mass flow controller 54.

As described at paragraph [0031] of the specification, the integrator 100 integrates the error signal over time to sooth the signal by removing short term duration concentration variations in order to avoid controlling the etchant gas concentration in the etch chamber 50 in response to short term transients. However, as described at column 3, lines 7-25, the flow controller of Jerbic is adjusted in response to any change in the ratio between the concentration of the reactant gas and the non-reactant gas. Also, at column 4, lines 60-67, Jerbic described the actinometry apparatus change raising or lowering the set point of a chlorine flow controller whenever the ratio of chlorine concentration to argon concentration drops or rises. Thus, not only does Jerbic not disclose reducing the effect of short term variations on the control of the flow controller, Jerbic teaches responding to every short term variation by adjusting the controller. Furthermore, at no point does Jerbic disclose any integrator or adder connected to the flow controller. Although, column 4, lines 4-9 of Jerbic describe various types of flow controllers, there is no description of an integrator or adder. Therefore, Jerbic does not disclose "an integrator connected to an output terminal of said comparator to input said error signal output from said comparator, said integrator integrating said error signal over time," and "an adder having a first input terminal connected to an output terminal of said integrator to input the integrated error signal, a second input terminal inputting a recipe set

point value representing a nominal control voltage of said first mass flow controller, and an output terminal connected to said first mass flow controller, said adder adding said integrated error signal to said recipe set point value to generate a modified control signal and outputting said modified control signal to said first mass flow controller," as recited in claim 31.

Regarding claim 32, claim 32 recites the limitation of:

> a voltage divider circuit connected to said second input terminal of said comparator for generating said reference signal.

As illustrated in FIG. 3 and described at paragraph [0030] of the present invention, the reference signal representing the desired etchant gas concentration can be generated by a voltage divider circuit comprising an adjustable resistor 94 and a direct current voltage source 96. There is no voltage divider circuit disclosed in Jerbic. In addition to not disclosing a comparator or a reference signal, Jerbic does not disclose any voltage divider circuit, let alone a voltage divider circuit connected to an input terminal of a comparator for generating a reference signal. Thus, Jerbic fails to disclose "a voltage divider circuit connected to said second input terminal of said comparator for generating said reference signal," as recited in claim 32.

III. No New Matter

No new matter has been added by the amendments to claim 21 and new claims 31 and 32.

The amendments to claim 21 are supported at least at paragraph [0030] of the specification.

New claim 31 is supported at least at paragraph [0030] of the specification.

New claim 32 is supported at least at paragraph [0031] of the specification.

IV. Conclusion

For the reasons discussed above, all pending claims are allowable over the cited art. Reconsideration and allowance of all claims is respectfully requested.

Respectfully submitted,

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